OBJECT POSITION DETECTOR

CROSS-REFERENCE TO RELATED APPLICATION

This is a file-wrapper continuation of patent application Ser. No. 07/895,934, filed Jun. 8, 1992 now abandoned.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to object position sensing transducers and systems. More particularly, the present invention relates to object position sensors useful in applications such as cursor movement for computing devices and other applications.

2. The Prior Art

Numerous devices are available or have been proposed for use as object position detectors for use in computer systems and other applications. The most familiar of such devices is the computer "mouse". While extremely popular as a position indicating device, a mouse has mechanical parts and requires a surface upon which to roll its position ball. Furthermore, a mouse usually needs to be moved over long distances for reasonable resolution. Finally, a mouse requires the user to lift a hand from the keyboard to make the cursor movement, thereby upsetting the prime purpose, which is usually typing on the computer keyboard.

Trackball devices are similar to mouse devices. A major difference, however is that, unlike a mouse device, a trackball device does not require a surface across which it must be rolled. Trackball devices are still expensive, have moving parts, and require a relatively heavy touch as do the mouse devices. They are also large in size and doe not fit well in a volume sensitive application like a laptop computer.

There are several available touch-sense technologies which may be employed for use as a position indicator. Resistive-membrane position sensors are known and used in several applications. However, they generally suffer from poor resolution, the sensor surface is exposed to the user and is thus subject to wear. In addition, resistive-membrane touch sensors are relatively expensive. A one-surface approach requires a user to be grounded to the sensor for reliable operation. This cannot be guaranteed in portable computers. An example of a one-surface approach is the UnMouse product by MicroTouch, of Wilmington, Mass. A two-surface approach has poorer resolution and potentially will wear out very quickly in time.

Surface Acoustic Wave (SAW) devices have potential use as position indicators, However, this sensor technology is expensive and is not sensitive to light touch. In addition, SAW devices are sensitive to residue buildup on the touch surfaces and generally have poor resolution.

Strain gauge or pressure plate approaches are an interesting position sensing technology, but suffer from several drawbacks. This approach may employ piezo-electric transducers. One drawback is that the piezo phenomena is an AC phenomena and may be sensitive to the user's rate of movement. In addition, strain gauge or pressure plate approaches are a somewhat expensive because special sensors are required,

Optical approaches are also possible but are somewhat limited for several reasons. All would require light generation which will require external components and increase cost and power drain, For example, a "finger-breaking" infra-red matrix position detector consumes high power and suffers from relatively poor resolution.

BRIEF DESCRIPTION OF THE INVENTION

The present invention comprises a position-sensing technology particularly useful for applications where finger position information is needed, such as in computer "mouse" or trackball environments. However the position-sensing technology of the present invention has much more general application than a computer mouse, because its sensor can detect and report if one or more points are being touched. In addition, the detector can sense the pressure of the touch.

There are at least two distinct embodiments of the present invention. Both embodiments of the present invention include a sensor comprising a plurality of spaced apart generally parallel conductive lines disposed on a first surface.

According to a first embodiment of the present invention, referred to herein as a "finger pointer" embodiment, a position sensing system includes a position sensing transducer comprising a touch-sensitive surface disposed on a substrate, such as a printed circuit board, including a matrix of conductive lines. A first set of conductive lines runs in a first direction and is insulated from a second set of conductive lines running in a second direction generally perpendicular to the first direction. An insulating layer is disposed over the first and second sets of conductive lines. The insulating layer is thin enough to promote significant capacitive coupling between a finger placed on its surface and the first and second sets of conductive lines.

Sensing electronics respond to the proximity of a finger to translate the capacitance changes between the conductors caused by finger proximity into position and touch pressure information. Its output is a simple X, Y and pressure value of the one object on its surface. The matrix of conductive lines are successively scanned, one at a time, with the capacitive information from that scan indicating how close a finger is to that node. That information provides a profile of the proximity of the finger to the sensor in each dimension. The centroid of the profile is computed with that value being the position of the finger in that dimension. The profile of position is also integrated with that result providing the Z (pressure) information. The position sensor of the first embodiment of the invention can only detect the position of one object on its sensor surface. If more than one object is present, the position sensor of this embodiment tries to compute the centroid position of the combined set of objects.

According to a second embodiment of the present invention, a position sensing system includes a position sensing transducer as described herein. Sensing electronics respond to the proximity of a finger to translate the capacitance changes between the conductors running in one direction and those running in the other direction caused by finger proximity into position and touch pressure information. The sensing electronics of the second embodiment of the invention saves information for every node in its sensor matrix and can thereby give the full X/Y dimension picture of what it is sensing. It thus has much broader application for richer multi-dimensional sensing than does the first "finger pointer" embodiment. In this embodiment, referred to herein as the "position matrix" approach, the x,y coordinate information can be used as input to a on-chip neural network processor. This allows an operator to use multiple fingers, coordinated gestures, etc. for even more complex interactions.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1*a* is a top view of an object position sensor transducer according to a presently preferred embodiment of